

Program of Study Justifications for Transportation, Distribution, & Logistics

Program of Study	Page
Automotive Collision Repair	2
Automotive Maintenance & Light Repair	11
Aviation Flight	20
Distribution & Logistics	30



Automotive Collision Repair

2017-18 Program of Study	Level 1	Level 2	Level 3	Level 4
Automotive Collision Repair	Introduction to Collision Repair (6172)	Collision Repair: Non-Structural ¹ (6062) -or- Collision Repair: Painting & Refinishing ¹ (6063)	Collision Repair: Non-Structural ¹ (6062) -or- Collision Repair: Painting & Refinishing ¹ (6063) -or- Dual Enrollment Automotive & Collision Repair (4129)	Collision Repair: Non-Structural ¹ (6062) -or- Collision Repair: Painting & Refinishing ¹ (6063) -or- Collision Repair: Damage Analysis, Estimating, & Customer Service (6149) -or- Dual Enrollment Automotive & Collision Repair (4129)
			Industry Certification for 6062: I-CAR Refinish Technician ProLevel 1 or I-CAR Non-Structural Technician ProLevel 1 or Automotive Service Excellence Student Certification: Nonstructural Analysis/Repair Industry Certification for 6063: Automotive Service Excellence Student Certification: Painting and Refinishing Industry Certification for 6064: Automotive Service Excellence Student Certification: Structural Analysis/Repair	

Description

The *Automotive Collision Repair* program of study prepares students for entry into careers as professional service technicians. Content emphasizes customer service skills, proper use of tools and equipment, safety, shop operations, engine fundamentals, damage analysis, cost estimation, painting and refinishing, and structural and non-structural repair in a hands-on environment. Upon completion of this program of study, students will be eligible to take the examination for Automotive Student Excellence (ASE) Student Certification in Collision Repair or I-CAR ProLevel 1.

ASE Student Certification may be obtained any time during the third or fourth level course. No work requirements are necessary to sit for the exam. Upon completion of this program of study, students will be prepared to enter the workforce or further their training at technical schools such as Tennessee College of Applied Technology (TCAT) or enter a university. Students who obtain the ASE student certification may be able to articulate hours at TCAT. Students may gain job experience while still in high school through local and CTSO competitions and work-based learning.

Job Outlook

The TN Department of Labor and Workforce Development projects 95 average annual openings for automotive body and related repairers due to growth and replacement from 2014 to 2024 with a total of 3,690 employed in the group in 2024.¹ This reflects an 8 percent change in the occupation group in Tennessee for the period 2014 to 2024. Nationally, the growth rate is slightly higher with a 9 percent change predicted.² Students in Automotive Collision Repair may also pursue related careers as automotive specialty technicians where there are a high number of annual average openings that are anticipated or automotive glass installers and repairers where there is a low number of annual average openings that are anticipated.

In recent years, the business layout of the automotive collision repair industry has shifted to fewer small shops and more large shops. A 2016 survey indicated that large shops (those with annual sales over \$1 million) have increased to a share of 68.1% of all shops in 2016 whereas the share was 15.3% in 1995.³

1 TN Department of Labor and Workforce Development. (2017). Employment Security Division, R & S. Retrieved from <https://www.jobs4tn.gov>.

2 Bureau of Labor Statistics, U.S. Department of Labor, *Occupational Outlook Handbook, 2016-17 Edition*, Automotive Body and Glass Repairers, Retrieved from <http://www.bls.gov/ooh/installation-maintenance-and-repair/automotive-body-and-glass-repairers.htm>.

3 Snapshot of the Collision Repair Industry (2016). Collision Repair Education Foundation, I-CAR. Retrieved from <http://collisioneducationfoundation.org/2013/11/2013-snapshot-of-the-collision-industry/>.

Related occupations requiring associates or bachelor's degrees include mechanical engineers and mechanical engineering technicians. The TN Department of Labor and Workforce Development projects 195 annual average openings for mechanical engineers and 35 annual average openings for mechanical engineering technicians.

Figure 1. Annual Average Openings for Automotive Body and Repairers in Tennessee (2014-2024)



Anticipated openings for automotive body and related repairers are spread fairly evenly across the state with the greatest concentration in the Nashville area and the Southeast section of the state (See **Figure 1**). The job outlook for the collision repair technology group statewide is very competitive. Although the growth rate is positive, there were 3 times as many training completers (or more) in a recent year as job openings expected annually.

Figure 2. Tennessee employment projections for occupation openings related to Automotive Body and Related Repairers 2014-2024⁴

Occupation	2014 Estimated Employment	2024 Projected Employment	Total 2014 - 2024 Employment Change	Annual Avg. Percent Change	Median Salary
Automotive Master Mechanics	15,590	16,840	1,250	0.8%	\$38,190
Automotive Service Technicians and Mechanics	15,590	16,840	1,250	0.8%	\$38,190
Automotive Specialty Technicians	15,590	16,840	1,250	0.8%	\$38,190
Bus and Truck Mechanics and Diesel Engine Specialists	5,430	5,860	430	0.8%	\$42,920
Automotive Body and Related Repairers	3,390	3,690	300	0.8%	\$36,950
Tire Repairers and Changers	2,910	3,370	460	1.5%	\$31,360
Aircraft Mechanics and Service Technicians	1,830	1,720	-110	-0.7%	\$54,340
Farm Equipment Mechanics and Service Technicians	810	910	100	1.2%	\$32,740
Motorcycle Mechanics	370	400	30	0.9%	\$37,530

⁴ Tennessee Department of Labor and Workforce Development, Jobs4TN Online. (2016). Occupational Projections on the internet at <https://www.jobs4tn.gov/vosnet/analyzer/results.aspx?session=occproj>

Motorboat Mechanics and Service Technicians	300	330	30	0.9%	\$36,860
Automotive Glass Installers and repairers	230	240	10	0.7%	\$34,290
Recreational Vehicle Service Technicians	210	230	20	1.1%	\$39,840

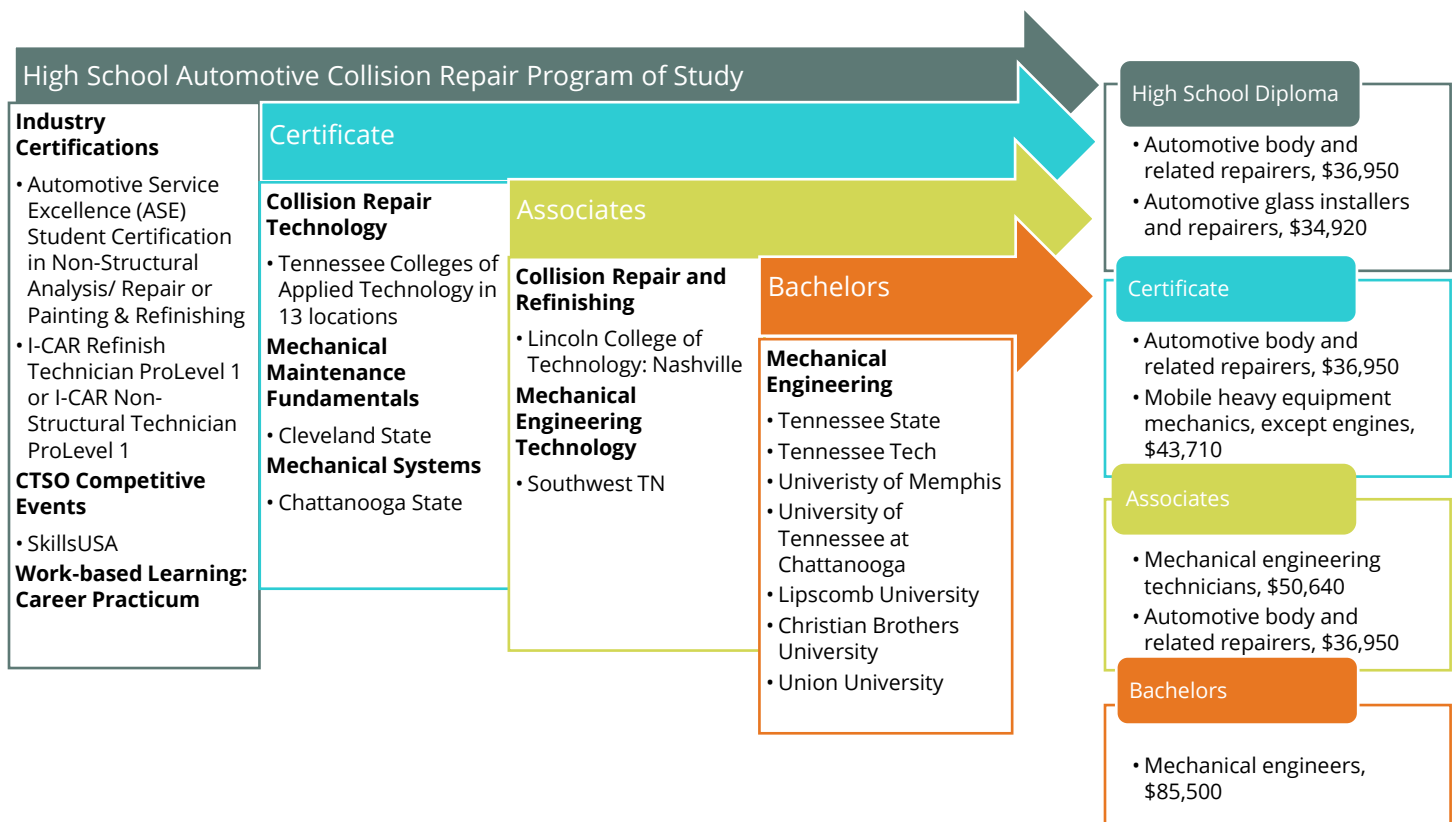
Figure 3. State and national trends for automotive body and related repairers with positive projections 2014-24.⁵

	Employment		Percent Change	Projected Annual Job Openings
	2014	2024		
National				
Automotive Body and Related Repairers	149,700	163,500	9%	4,810
	Employment		Percent Change	Projected Annual Job Openings
	2014	2024		
Tennessee				
Automotive Body and Related Repairers	3,390	3,690	+9%	100

⁵ Career One Stop. (2017). *Occupation Profile, State and National Trends*. Retrieved from <http://www.onetonline.org/link/summary/21-1093.00>

Postsecondary Pathways

Upon completion of this program of study, students will be prepared to enter the workforce or to further their training at postsecondary institutions.⁶ The chart below outlines the related career opportunities and the training necessary for each. While a high school diploma is typically the minimum requirement for an automotive service technician, some employers may prefer mechanics with training from a postsecondary institution. Automotive Technology programs are available at technical and community colleges across Tennessee. Long term on-the-job training is essential for an individual to become fully qualified in the occupation. Students who are interested in pursuing related study in a four year university may seek bachelor's degrees in mechanical engineering.



⁶ Bureau of Labor Statistics, U.S. Department of Labor, *Occupational Outlook Handbook, 2016-17 Edition*, Automotive Body and Glass Repairers, Retrieved from <http://www.bls.gov/ooh/installation-maintenance-and-repair/automotive-body-and-glass-repairers.htm>.



Current Secondary Landscape

In the 2013-14 School Year, 2,389 students were enrolled in an Automotive Collision Repair course (not including the Transportation Core course). Between 2011 and 2013, the number of students enrolled in a collision repair course grew slightly by about 75 students. In 2016-17, the Automotive Collision Repair program of study was offered in 48 schools and in 2017-18 it is projected to increase to 56 schools offering an Automotive Collision Repair course.

Figure 5. Open Enrollment Analysis, Schools offering Automotive Collision Repair POS.⁷

SY	Automotive Collision Repair
2013-14	No data
2014-15	46
2015-16	44
2016-17	48
2017-18	56

⁷ Tennessee Department of Education. (2017). *Student Enrollment Data*. Retrieved from Author's calculation of student enrollment data.

Student Enrollment in Automotive Collision Repair Program of Study Courses.

SY	Introduction to Collision Repair	Collision Repair: Non-Structural -or- Collision Repair: Painting & Refinishing	Collision Repair: Non-Structural -or- Collision Repair: Painting & Refinishing -or- Dual Enrollment Automotive & Collision Repair	Collision Repair: Non-Structural -or- Collision Repair: Painting & Refinishing -or- Collision Repair: Damage Analysis, Estimating, & Customer Service -or- Dual Enrollment Automotive & Collision Repair
2013-14	0	1,426	1,426	1,426
2014-15	0	1,338	1,338	1,357
2015-16	506	1,302	1,338	1,377
2016-17	N/A	N/A	N/A	N/A

Automotive Collision Repair Concentrators.

SY	Automotive Collision Repair Concentrators
2013-14	0
2014-15	358
2015-16	449
2016-17	N/A

Recommendation

No changes to the progression of program of studies are recommended at this time, however, NC3 certifications in Mechanical and Electronic Torque, Multimeter, and Precision Measurement Instruments should be examined further by Industry and postsecondary partners to evaluate their viability.

2018-19 Program of Study	Level 1	Level 2	Level 3	Level 4
Automotive Collision Repair	Introduction to Collision Repair (6172)	Collision Repair: Non-Structural ¹ (6062) -or- Collision Repair: Painting & Refinishing ¹ (6063)	Collision Repair: Non-Structural ¹ (6062) -or- Collision Repair: Painting & Refinishing ¹ (6063) -or- Dual Enrollment Automotive & Collision Repair (4129)	Collision Repair: Non-Structural ¹ (6062) -or- Collision Repair: Painting & Refinishing ¹ (6063) -or- Collision Repair: Damage Analysis, Estimating, & Customer Service (6149) -or- Dual Enrollment Automotive & Collision Repair (4129)
			<p>Industry Certification for 6062:</p> <p>I-CAR Refinish Technician ProLevel 1 or I-CAR Non-Structural Technician ProLevel 1 or Automotive Service Excellence Student Certification: Nonstructural Analysis/Repair</p> <p>Industry Certification for 6063:</p> <p>Automotive Service Excellence Student Certification: Painting and Refinishing</p> <p>Industry Certification for 6064:</p> <p>Automotive Service Excellence Student Certification: Structural Analysis/Repair</p>	

References

- College Repair Education Foundation, I-CAR. (2016). *Snapshot of the Collision Repair Industry*. Retrieved from <http://collisioneducationfoundation.org/2013/11/2013-snapshot-of-the-collision-industry/>
- Tennessee Department of Education. (2015). Student Enrollment Data. Retrieved from Author's calculation of student enrollment data.
- Tennessee Department of Labor & Workforce Development, Jobs4TN Online. (2016). *Occupational Projections*. Retrieved from <https://www.jobs4tn.gov/vosnet/analyzer/results.aspx?session=occproj>
- Tennessee Department of Labor & Workforce Development, Jobs4TN Online. (2016). *Employment Wage and Data*. Retrieved from <https://www.jobs4tn.gov/vosnet/analyzer/results.aspx?session=occproj>
- Tennessee Department of Labor & Workforce Development, Jobs4TN Online. (2016). *Labor Supply and Demand for Tennessee*. Retrieved from <https://www.jobs4tn.gov/vosnet/Default.aspx>
- United States Department of Labor, Bureau of Labor Statistics. (2017, April 26). Occupational Outlook Handbook, 2016-17 Edition. Retrieved from <https://www.bls.gov/ooh/>.
- United States Department of Labor, Employment and Training Administration. (2016). *Career One Stop*. Retrieved from <https://www.careeronestop.org/>.

Automotive Maintenance & Light Repair

2017-18 Program of Study	Level 1	Level 2	Level 3	Level 4
Automotive Maintenance and Light Repair	Maintenance and Light Repair I (5879)	Maintenance and Light Repair II (5880)	Maintenance and Light Repair III (5881) -or- Dual Enrollment Automotive Maintenance & Light Repair (4128)	Maintenance and Light Repair IV (5882) -or- Dual Enrollment Automotive Maintenance & Light Repair (4128)
				Industry Certification: Automotive Service Excellence Student Certification: Maintenance & Light Repair

Description

Automotive Maintenance and Light Repair courses prepare students for entry into the automotive service industry with an ASE Student Certification or for entry into another maintenance occupation dealing with automotive technologies. Students service automotive HVAC systems, engine performance systems, automatic and manual transmission and transaxle systems, and practice workplace soft skills. Upon completion of this program of study, students will be equipped with the knowledge and skills to be a successful automotive service technician, have satisfied course requirements to meet the National Automotive Technicians Education Foundation (NATEF) standards, and be prepared to pursue further study at a technology center or other postsecondary institution.

ASE Student Certification may be obtained any time during the third or fourth level course. No work requirements are necessary to sit for the exam. Additionally, students completing the *MLR* program of study through a NATEF-certified program may receive work experience to count toward the requirements for ASE Auto Maintenance and Light Repair Certification (G1). With additional work experience outside the classroom, students could obtain the G1 certification at the completion of the program of study. Students may gain job experience while still in high school through local and CTSO competitions and work-based learning. Dual credit/dual enrollments opportunities may be established with local postsecondary institutions.

Job Outlook

The TN Department of Labor and Workforce Development projects 520 average annual openings for automotive service technicians and mechanics due to growth and replacement from 2014 to 2024 with a total of 16,840 employed in the group in TN in 2024.⁸ This reflects an 8 percent change in the occupation group in Tennessee. Nationally, the growth rate is a little lower with a 5% change predicted.⁹ Median annual salaries in 2016 for automotive service technicians and mechanics in TN was \$38,190. Additionally, 150 annual average openings are projected for tire repairers and changers who had an annual median wage of \$31,360 in 2016.

Figure 1. Tennessee employment projections for automotive maintenance and light repair related occupations with positive openings projected 2014-2024¹⁰

Occupation	2014 Estimated Employment	2024 Projected Employment	Total 2014 - 2024 Employment Change	Annual Avg. Percent Change	Median Salary
Automotive Master Mechanics	15,590	16,840	1,250	0.8%	\$38,190
Automotive Service Technicians and Mechanics	15,590	16,840	1,250	0.8%	\$38,190
Automotive Specialty Technicians	15,590	16,840	1,250	0.8%	\$38,190
Bus and Truck Mechanics and Diesel Engine Specialists	5,430	5,860	430	0.8%	\$49,920

⁸ Tennessee Department of Labor and Workforce Development. (2017). Employment Security Division, R & S. Retrieved from <https://www.jobs4tn.gov>.

⁹ Bureau of Labor Statistics, U.S. Department of Labor, *Occupational Outlook Handbook, 2016-17 Edition*, Automotive Service Technicians and Mechanics, Retrieved from <http://www.bls.gov/ooh/installation-maintenance-and-repair/automotive-service-technicians-and-mechanics.htm>.

¹⁰ Tennessee Department of Labor and Workforce Development, Jobs4TN Online. (2017). Occupational Projections on the internet at <https://www.jobs4tn.gov/vosnet/analyzer/results.aspx?session=occproj>

Automotive Body and Related Repairers	3,390	3,690	300	8.8%	\$36,950
Tire Repairers and Changers	2,910	3,370	460	1.5%	\$31,360
Mobile Heavy Equipment mechanics, Except Engines	Confidential	Confidential	Confidential	Confidential	Confidential
Outdoor Power Equipment and Other Small Engine Mechanics	820	890	60	0.70%	\$29,710
Farm Equipment Mechanics and Service Technicians	810	910	100	1.20%	\$32,740
Automotive Glass Installers and Repairers	230	240	20	0.70%	\$34,290

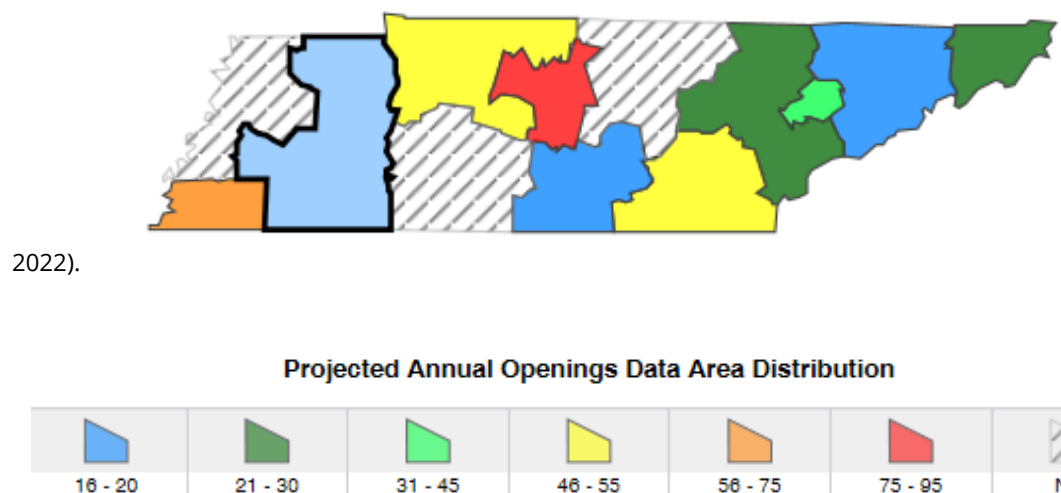
Figure 2. State and national trends for Automotive Service Technicians and Mechanics with positive projections 2014-24.¹¹

National	Employment		Percent Change	Projected Annual Job Openings
	2014	2024		
Automotive Service Technicians and Mechanics	740,000	977,200	5%-8%	23,720

¹¹ Career One Stop. (2017). *Occupation Profile, State and National Trends*. Retrieved from <http://www.onetonline.org/link/summary/21-1093.00>

National	Employment		Percent Change	Projected Annual Job Openings
	2014	2024		
Tennessee	Employment		Percent Change	Projected Annual Job Openings
	2014	2024		
Automotive Service Technicians and Mechanics	15,590	16,840	8%	520

Figure 3. Annual Average Openings for Automotive Service Technicians and Mechanics in Tennessee (2014-



Openings for automotive service technicians are available across the state with greater concentrations in urban and surrounding areas. (See Figure 3). The outlook for automotive service technicians and tire repairers and changers statewide is very competitive. Although the growth rates are positive, there were more training completers in recent years than job openings expected.

Related occupations requiring associates or bachelor's degrees include mechanical and electrical engineers and technicians. The TN Department of Labor and Workforce Development projects 195 annual average openings for mechanical engineers and 35 annual average openings for mechanical engineering technicians. These engineers may find opportunity in the growing automotive manufacturing industry in Tennessee. A recent study by the Brookings Institution found that Tennessee has more than 900 automotive-related manufacturers. In fact, most Tennessee counties have at least one automotive-related manufacturer (80 out of 95).¹² Figure 4 illustrates the widespread presence of automotive manufacturing in Tennessee.

Figure 4. Location of industries and businesses in Tennessee devoted to auto manufacturing or supply. 80 out of 95 counties have at least one automotive business or industry.¹³



Postsecondary Opportunities

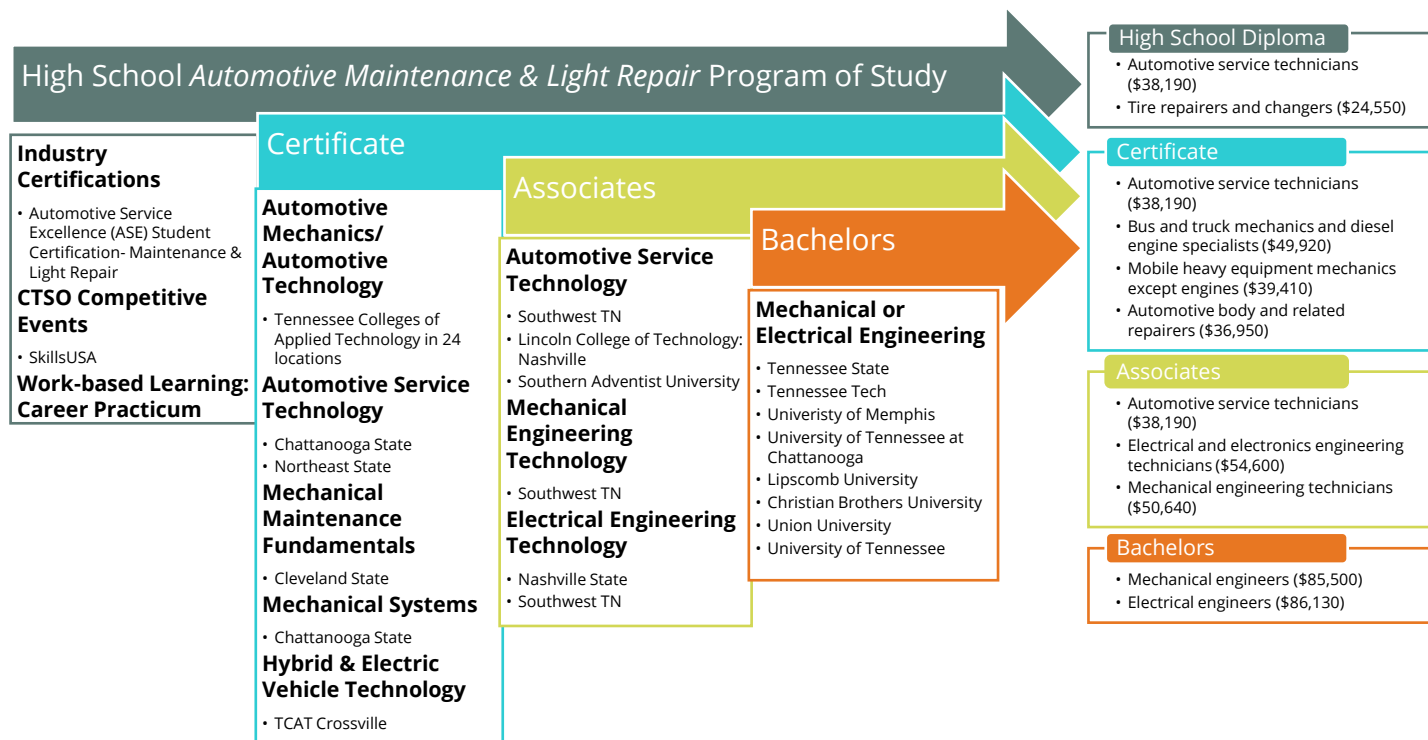
Upon completion of this program of study, students will be prepared to enter the workforce or to further their training at postsecondary institutions.¹⁴ The chart below outlines the related career opportunities and the training necessary for each. While a high school diploma is typically the minimum requirement for an automotive service technician, some employers may prefer mechanics with training from a postsecondary institution. Automotive Technology programs are available at technical and community colleges across Tennessee. Long term on-the-job training is essential for an individual to become fully qualified in the occupation.

¹² Muro, M., Andes, S., Fikri, K., Ross, M., Lee, J., Ruiz, N., and Marchio, N., (4 Oct. 2013). Drive! Moving Tennessee's Automotive Sector UP the Value Chain. Retrieved from http://www.brookings.edu/research/reports/2013/10/04-tennessee-automotive?mc_cid=edf4e54454&mc_eid=a30e70b6c6.

¹³ Tennessee Department of Economic and Community Development. Retrieved from http://tntoday.utk.edu/2016/01/11/ut-announces-plans-automotive-engineering-concentration/?mc_cid=edf4e54454&mc_eid=a30e70b6c6.

¹⁴ Bureau of Labor Statistics, U.S. Department of Labor, *Occupational Outlook Handbook, 2016-17 Edition*, Automotive Service Technicians and Mechanics, Retrieved from <http://www.bls.gov/ooh/installation-maintenance-and-repair/automotive-service-technicians-and-mechanics.htm>.

Students who are interested in pursuing related study in a four year university may seek bachelor's degrees in mechanical or electrical engineering. In response to the large automotive manufacturing presence in Tennessee, the University of Tennessee at Knoxville has proposed a graduate concentration in Automotive Manufacturing Simulation and Design in Mechanical Engineering.



Current Secondary Landscape

In the 2013-14 School Year, 3,758 students were enrolled in an Automotive Maintenance & Light Repair course. During the 2015-16, the number of students enrolled in Automotive Maintenance & Light Repair courses increased to 8,922.

In the 2014-15 school year, the Automotive Maintenance and Light Repair program of study was offered in 118 schools and in 2016-17 that number grew to 135 and is projected to reach 143 for the 2017-18 school year. The number of students classified as concentrators in Automotive Maintenance & Light Repair swelled from 573 in 2013-14 to 1,441 in the 2015-16 school year. Lastly, 150 students enrolled in Dual Enrollment Automotive Maintenance & Light Repair for 2015-16.

Open Enrollment Analysis, Schools offering Automotive Maintenance and Light Repair POS.¹⁵

SY3	Automotive Maintenance and Light Repair
2013-14	No data
2014-15	118
2015-16	118
2016-17	134
2017-18	143

Student Enrollment for Automotive Maintenance and Light Repair POS courses.

SY	Maintenance and Light Repair I	Maintenance and Light Repair II	Maintenance and Light Repair III -or- Dual Enrollment Automotive Maintenance & Light Repair	Maintenance and Light Repair IV -or- Dual Enrollment Automotive Maintenance & Light Repair	Dual Enrollment Automotive Maintenance & Light Repair Totals
2013-14	1661	1345	480	272	0
2014-15	4433	2587	1540	513	0
2015-16	4166	2572	1617	567	150
2016-17	N/A	N/A	N/A	N/A	N/A

Automotive Maintenance and Light Repair Concentrators.

SY	Automotive Maintenance and Light Repair Concentrators
2013-14	573
2014-15	1265
2015-16	1441
2016-17	N/A

¹⁵ Tennessee Department of Education. (2017). *Student Enrollment Data*. Retrieved from Author's calculation of student enrollment data.

Recommendation

No changes as this time. NC3 certifications in Mechanical and Electronic Torque, Multimeter, and Precision Measurement Instruments should be examined further by Industry and postsecondary partners to evaluate their viability.

2018-19 Program of Study	Level 1	Level 2	Level 3	Level 4
Automotive Maintenance and Light Repair	Maintenance and Light Repair I (5879)	Maintenance and Light Repair II (5880)	Maintenance and Light Repair III (5881) -or- Dual Enrollment Automotive Maintenance & Light Repair (4128)	Maintenance and Light Repair IV (5882) -or- Dual Enrollment Automotive Maintenance & Light Repair (4128)
				Industry Certification: Automotive Service Excellence Student Certification: Maintenance & Light Repair

References

Bureau of Labor Statistics, U.S. Department of Labor, *Occupational Outlook Handbook, 2016-17*

Edition, Automotive Service Technicians and Mechanics, Retrieved from
<http://www.bls.gov/ooh/installation-maintenance-and-repair/automotive-service-technicians-and-mechanics.htm>.

Muro, M., Andes, S., Fikri, K., Ross, M., Lee, J., Ruiz, N., and Marchio, N., (4 Oct. 2013). Drive! Moving Tennessee's Automotive Sector UP the Value Chain. Retrieved from
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Tennessee Department of Economic and Community Development. Retrieved from
http://tntoday.utk.edu/2016/01/11/ut-announces-plans-automotive-engineering-concentration/?mc_cid=edf4e54454&mc_eid=a30e70b6c6.

Tennessee Department of Labor and Workforce Development. (2016). Employment Security Division, R & S. Retrieved from <https://www.jobs4tn.gov>.

UT Announces Plans to Begin Automotive Engineering Concentration (11 Jan. 2016). Retrieved from
http://tntoday.utk.edu/2016/01/11/ut-announces-plans-automotive-engineering-concentration/?mc_cid=edf4e54454&mc_eid=a30e70b6c6.

Aviation Flight

2017-18 Program of Study	Level 1	Level 2	Level 3	Level 4
Aviation Flight	Introduction to Aerospace (6068)	Aviation I: Principles of Flight (6070)	Aviation II: Advanced Flight (6148) -or- Dual Enrollment Aviation Flight (4130)	Work-Based Learning: Career Practicum (6105) -or- Dual Enrollment Aviation Flight (4130)

Description

Aviation Flight is a pathway intended to prepare students to be successful in a range of aviation careers, such as pilots, aircraft engineers, air traffic control specialists, aircraft mechanics, or airline statisticians. Course content covers the knowledge and skills of all aspects of flight needed to pass the Federal Aviation Administration (FAA) Private Pilot written exam, including aircraft structures, flight environment, procedures and regulations, aerodynamics of flight, judgment training, navigation, communications, and more. Upon completion of this program of study, students will be prepared to take the FAA Private Pilot written exam and will be able to advance more quickly through the training hours typically required to solo in an aircraft after graduating. Students may gain related job experience while still in high school through work-based learning and local and CTSO competitions. Dual credit/dual enrollment opportunities may be established with local postsecondary institutions.

Job Outlook

Air Transportation Workers

Amongst the air transportation workers occupation group projected to grow in Tennessee between 2014 and 2024 is commercial pilots at 13.5 %, aerospace engineering at 23%, and transportation inspectors at 6.5%. On a smaller scale, avionics technicians with less total employees in the workforce has a 4.5% growth expectation. All of the above mentioned occupation groups range in average salary from \$46,570 to \$71,020. Others in this occupation group including air traffic controllers, airline pilots, copilots, flight engineers, aircraft mechanics and service technicians are expected to see decreases in annual job openings. Aircraft mechanics and service technicians will be hit the hardest with a yearly decrease of 7%. Yearly review of the air transportation work force is vital as the marketplace for job openings appears to be dynamic and volatile.

Aerospace Engineering

Students enrolled in the Aviation Flight program of study may also use their training to pursue careers as aerospace engineers. A significant increase in aerospace engineer employment is expected from 2014-2024. A large cluster of aerospace engineers are employed just south of Middle Tennessee in the Huntsville, Alabama area. Huntsville was the metropolitan area with the third highest employment level in this occupations and the metropolitan area with the highest concentration with a location quotient of 28.49. **Figure 1** provides more information about aviation flight careers including average salaries.

Unmanned Aerial Systems

Although the Bureau of Labor Statistics has not yet categorized unmanned aerial system (UAS) operators outside of military specific occupations, the rise in interest of commercial use of this technology is significant. Though passage of legislation occurred in August, 2016, more data is needed to evaluate its' impact on the labor force. A recent study by the Association for Unmanned Vehicle Systems International (AUVSI), projects that if UAS were allowed in the National Airspace System (NAS) in 2015 more than 100,000 new jobs would be created in the UAS field by 2025. In 2015, an employment of 99 was reported in the UAS field in Tennessee.

The report indicates that the number will triple to 297 within two years and grow to 439 within 10 years.¹⁶ Starting salaries of least \$60,000 are available for UAS pilots.¹⁷

Knowledge and skills needed for those working in the UAS field include a strong understanding of aerodynamics, operation skills, and engineering skills. UAS have application in a broad spectrum of fields including agriculture, delivery services, A/V production, telecommunications, disaster management, law enforcement, mapping, weather monitoring, and freight transport. Jenkins and Vasigh conclude that public safety and agriculture are the “most promising commercial and civil markets.”

Figure 1. Annual Average Openings Projected for Aerospace Occupations in Tennessee (2014-2024).¹⁸

Occupation	2014 Estimated Employment	2024 Projected Employment	Total 2014 - 2024 Employment Change	Annual Avg. Percent Change	Median Salary
Airline Pilots, Copilots, and Flight Engineers	470	390	-80	-1.7%	\$89,660
Commercial Pilots	370	420	50	1.2%	\$64,460
Air Traffic Controllers	660	580	-80	-1.3%	\$130,130
Aerospace Engineers	260	320	60	1.9%	\$87,390
Aerospace Engineering and Operations Technicians	60	60	0	0.0%	\$65,360

¹⁶ Jenkins, D., & Vasigh, B. (March 2013). The Economic Impact of Unmanned Aircraft Systems Integration in the United States. Retrieved from <http://www.auvsi.org/auvsiresources/economicreport>.

¹⁷ Bergqvist, P. (16 June 2014). Drone Jobs: What It Takes to Fly a UAV. Retrieved from <http://www.flyingmag.com/aircraft/drone-jobs-what-it-takes-fly-uav>.

¹⁸ Tennessee Department of Labor and Workforce Development, Jobs4TN Online. (2016). Occupational Projections on the internet at <https://www.jobs4tn.gov/vosnet/drills/occupation/occdrill.aspx?enc=Z09Zl8FIdmjYMiLFF3lu2CGUmb62mVkUQ3jy06V2elw=>

Transportation Inspectors	460	490	30	0.6%	\$71,020
Aircraft Mechanics and Service Technicians	1,830	1,720	-110	-0.7%	\$54,340
Avionics Technicians	210	220	10	0.5%	\$46,570
First-Line Supervisors of Mechanics, Installers, and Repairers	8,980	9,850	870	0.9%	\$59,260
Transportation, Storage, and Distribution Managers	3,600	4,050	370	1.0%	\$72,230

The Memphis area was reported to have the highest concentration of employment of airline pilots, copilots, and flight engineers in May 2014 with 310 reported to be employed.¹ The Greater Memphis Chamber has named Memphis as America's Aerotropolis because of its large airport and surrounding transportation linkages from distribution centers and manufacturing facilities to its roadways, waterways, and railways.¹⁹ The Memphis-Shelby County International Airport sees approximately 300 daily cargo flights mostly through FedEx and many additional flights in airline passenger service. Because of this, Memphis has a higher concentration of airline and commercial pilots with a location quotient of 1.61 and employment of 0.89 per thousand jobs.²⁰

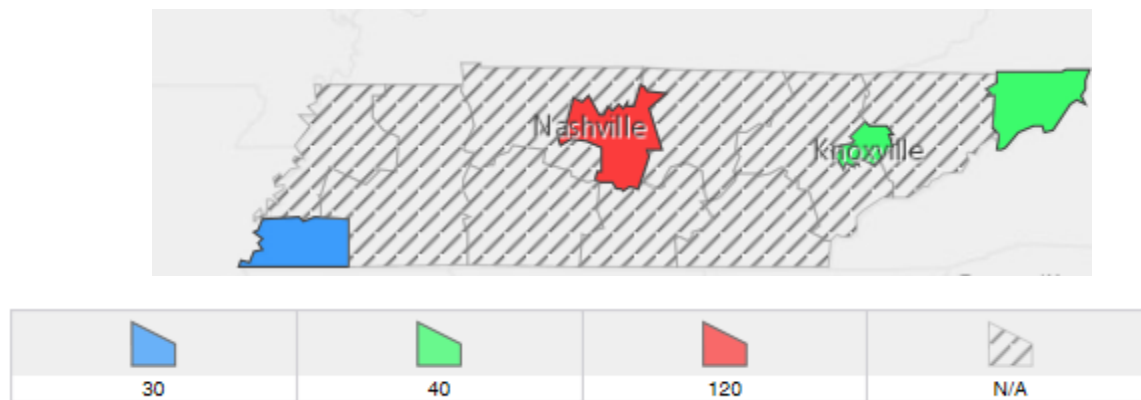
The Tri-Cities area also has an aviation industry presence. Bell Helicopter has teamed up with Northeast State to provide aviation maintenance training. An aviation park has been designed for aerospace industry to move into the area.²¹ As the industry grows, the need for pilots and air traffic controllers in this area may increase as well.

¹⁹ *Memphis: America's Aerotropolis, Executive Summary, 2009*. Greater Memphis Chamber. On the internet at http://www.memphischamber.com/Articles/DoBusiness/Aero_Exec_Summ.aspx (visited February 12, 2015).

²⁰ Bureau of Labor Statistics, U.S. Department of Labor, *Occupational Employment and Wages, May 2013*, Retrieved from <http://www.bls.gov/oes/current/oes271025.htm> (visited Feb. 9, 2015).

²¹ Lowery, L., (5 Sept. 2014). Northeast State will offer 2-year aviation program. *Bristol Herald Courier*. Retrieved from http://www.tricitie.com/news/article_6dd96efe-356c-11e4-b6e0-001a4bcf6878.html.

Figure 2. The map below shows the distribution of the 2014 estimated employment for Commercial Pilots in Tennessee by the workforce development regions.



Employment Data Area Distribution

Figure 3. State and national trends for commercial pilots with positive projections 2014-24.²²

National	Employment		Percent Change	Projected Annual Job Openings
	2014	2024		
Commercial Pilots	43,500	48,000	11%	1,510
Tennessee	Employment		Percent Change	Projected Annual Job Openings
	2014	2024		
Commercial Pilots	370	420	13%	20

²² Career One Stop. (2017). *Occupation Profile, State and National Trends*. Retrieved from <http://www.onetonline.org/link/summary/21-1093.00>

Postsecondary Opportunities

Upon completion of this program of study, students will be prepared to further their training at technical schools and universities in various areas of aerospace. Students may pursue bachelor's degrees with majors in aerospace engineering, aerospace technology, professional pilot, and more. Students may pursue associate's degrees in air traffic control. Students may enter the workforce as commercial pilots. Students may pursue educational opportunities available through the United States Air Force or other military divisions.

Training available in Tennessee includes the MTSU Aerospace Program which awards bachelor's degrees in the following concentrations: aerospace technology, flight dispatch, professional pilot, maintenance management, aviation administration, and UAS operations. A Master's degree in Aviation Administration is also available. In addition to this program, students may complete the Air Traffic Control program at MTSU and be prepared to attend the FAA Training Academy in Oklahoma City and become an air traffic controller.²³ The University of Tennessee of Knoxville offers a bachelor's degree in Aerospace Engineering. Tennessee State University offers a bachelor's degrees in Aviation Flight Training and Aviation Management in which the first two years may be taken at Columbia State Community College. Northeast Tennessee Community College was reported to begin offering courses in aviation technology in the fall of 2014 and is making plans to add aviation to the offerings at East Tennessee State University.²⁴

The study of unmanned aerial systems is emerging within postsecondary programs across the country and worldwide. At least 50 accredited colleges worldwide offer bachelor's degrees in UAS, including Embry-Riddle Aeronautical University who also offers a Master of Science in Unmanned Systems. MTSU added a concentration in UAS operations within the B.S. in Aerospace degree in the Fall of 2015. The aligned coursework for the UAS operations concentration requires students to build and fly UAS in addition to preparing for the private pilot license for manned vehicles and studying in many interdisciplinary areas including electricity, computer science, GIS, agriculture, and business. **Figure 3** on the following page provides more information about the available aviation flight pathways in Tennessee.

²³ Middle Tennessee State University Department of Aerospace. Retrieved from <http://www.mtsu.edu/aerospace/>.

²⁴ Lowery, L., (5 Sept. 2014). Northeast State will offer 2-year aviation program. *Bristol Herald Courier*. Retrieved from http://www.tricities.com/news/article_6dd96efe-356c-11e4-b6e0-001a4bcf6878.html.

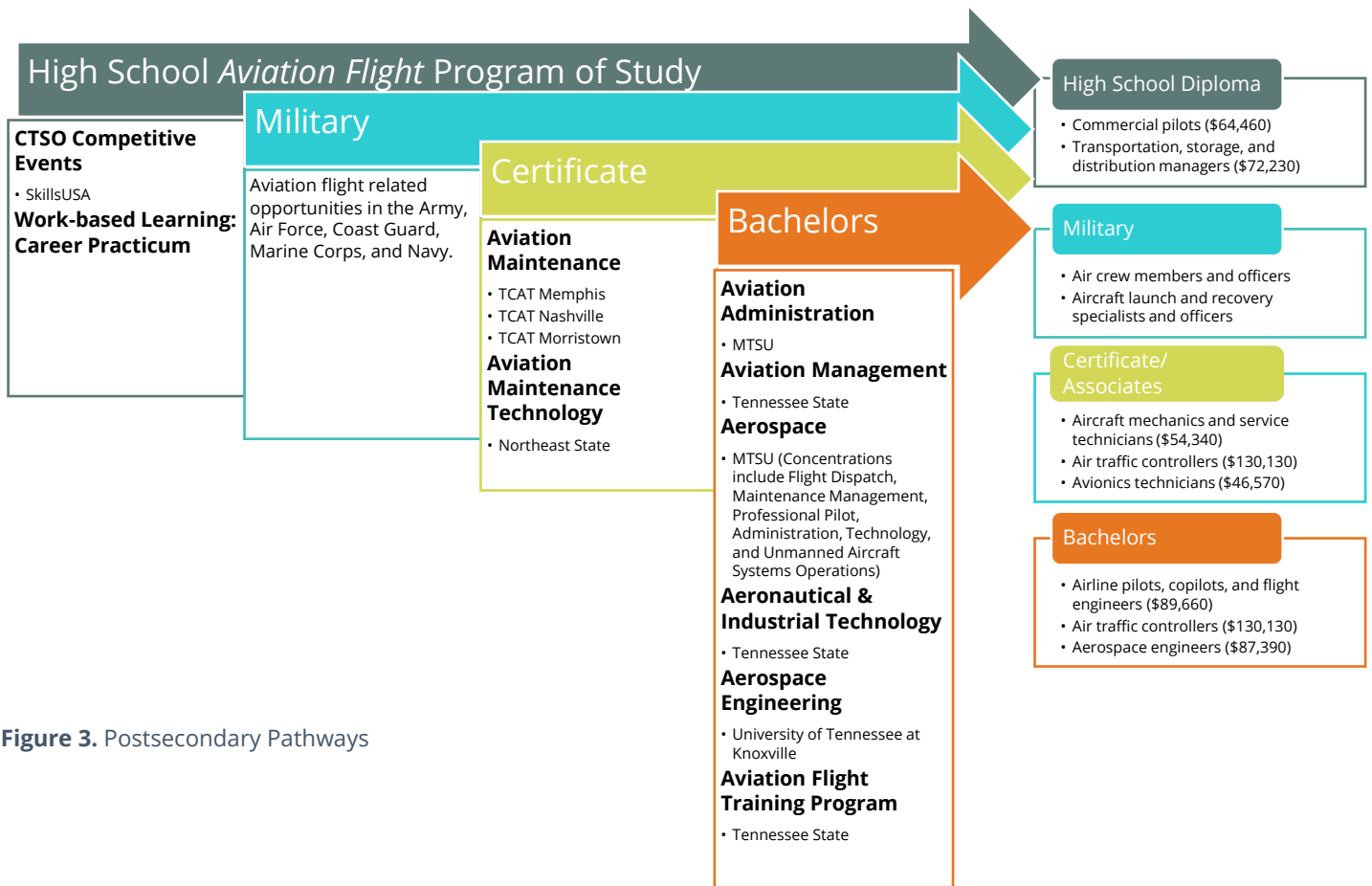


Figure 3. Postsecondary Pathways

Current Secondary Landscape

In the 2014-15 school year, 274 were enrolled in *Introduction to Aerospace* and 86 students were enrolled in *Aviation I: Principles of Flight* while 70 were enrolled in *Aviation II: Advanced Flight*. In 2014-15, 7 schools offered the Aviation Flight program of study. West Tennessee (Shelby County) has one of these schools, Middle Tennessee has two schools, and East Tennessee has 4 schools. Enrollment numbers grew in 2015-16 to 379 students enrolled in *Introduction to Aerospace* and a total of 182 students enrolled in *Aviation I: Principles of Flight* and *Aviation II: Advanced Flight*. See figure 5 on next page.

Figure 5. Open Enrollment Analysis²⁵

SY	Aviation Flight
2013-14	No data
2014-15	7
2015-16	7
2016-17	9
2017-18	14

Student Enrollment Data for Aviation Flight POS.

SY	Introduction to Aerospace	Aviation I: Principles of Flight	Aviation II: Advanced Flight -or- Dual Enrollment Aviation Flight	Work-Based Learning: Career Practicum -or- Dual Enrollment Aviation Flight
2013-14	208	137	0	N/A
2014-15	274	86	70	N/A
2015-16	379	122	60	N/A
2016-17	N/A	N/A	N/A	N/A

²⁵ Tennessee Department of Education. (2017). *Student Enrollment Data*. Retrieved from Author's calculation of student enrollment data.

Aviation Flight Concentrators.

SY	Aviation Flight
2013-14	8
2014-15	42
2015-16	53
2016-17	N/A

Recommendation

Due to the increasing interest in commercial use of UAS in a broad range of industries and the quickly anticipated release of FAA regulations allowing widespread commercial use, a UAS course should be considered for addition to the available aerospace course coverings. Unmanned Aerial Systems is an emerging area and relevant to many different industry applications such as aerial photography and land survey start-ups. This POS has proven to gain a lot of interest from students and the community. Nationwide data for industry growth is strong, however, because the industry is so new, regional and local labor data is not readily available. The UAS course should be focused on the operation of UAS and should be highly application based with multidisciplinary collaboration throughout. The course should fall in Level 3 or Level 4 of the Aviation Flight program of study. Since a strong knowledge base in aerodynamics and FAA pilot licenses are required for civil UAS operators, it is appropriate for this course to be an extension of the current Aviation Flight program of study. Job data and industry news should be carefully monitored in the coming year to determine if a critical mass of demand warrants the addition of a full UAS program of study.

2018-19 Program of Study	Level 1	Level 2	Level 3	Level 4
Aviation Flight	Introduction to Aerospace (6068)	Aviation I: Principles of Flight (6070)	Aviation II: Advanced Flight (6148) -or- Dual Enrollment Aviation Flight (4130)	Work-Based Learning: Career Practicum (6105) -or- Dual Enrollment Aviation Flight (4130)

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Distribution & Logistics

2017-18 Program of Study	Level 1	Level 2	Level 3	Level 4
Distribution and Logistics	Foundations of Transportation, Distribution, and Logistics (6069)	Distribution and Logistics I (6072)	Distribution and Logistics II: Management (6024) -or- Dual Enrollment Distribution & Logistics (4132)	Work-Based Learning: Career Practicum (6105) -or- Dual Enrollment Distribution & Logistics (4132)

Description

The Distribution & Logistics program of study prepares students for many management and operations careers in the transportation industry. In this program of study, students learn about the dynamics of distribution networks, the managing and tracking of inventory, how distribution and logistics operations fit within the supply chain of a product or a business, and the problem solving skills to design logistics solutions for businesses. Students will have had the opportunity to participate in a *Work-based Learning: Career Practicum* in a classroom setting or in a transportation, distribution, and logistics-related business, and be prepared for advanced postsecondary study in transportation, distribution, and logistics related fields.

Job Outlook

Tennessee stands out among other states with high employment numbers in the transportation and material moving occupations. In May 2016, Tennessee ranked 1st for the highest concentration of jobs and location quotient in this occupation group with a location quotient of 1.38 and employment of 95.38 per thousand jobs.²⁶ The Transportation and Material Moving occupation group is expected to add 21,340 jobs between 2014 and 2022 with 294,410 total employed and 9,230 average annual openings projected.²⁷

Nationally, the occupation group is projected to grow, as well. For transportation and material moving workers, over 2.8 million openings are projected between 2014 and 2024. The majority of these openings will be due to filling the vacancies due to a retiring workforce. In 2012, approximately 47 percent of current transportation and material moving workers were 45 years or older.²⁸ Of the 2.8 million projected openings, only 476,000 are due to growth, while the remaining 2.3 million projected openings are due to replacement.

Figure 1. Breakdown of Total U.S. Employment of Transportation and Material Moving Occupations by Sub Group, 2014

²⁶ Bureau of Labor Statistics, U.S. Department of Labor, (2015, March 25). *Occupational Employment and Wages, May 2014*. (53-0000 Transportation and Material Moving Occupations, Major Group). Retrieved from <http://www.bls.gov/oes/current/oes530000.htm>.

²⁷ TN Department of Labor and Workforce Development. (2016). Employment Security Division, R & S. Retrieved from <https://www.jobs4tn.gov>.

²⁸ Bureau of Labor Statistics, U.S. Department of Labor, (2016, Feb. 10) *Current Population Survey (CPS)*. Retrieved from <http://www.bls.gov/cps/tables.htm>.

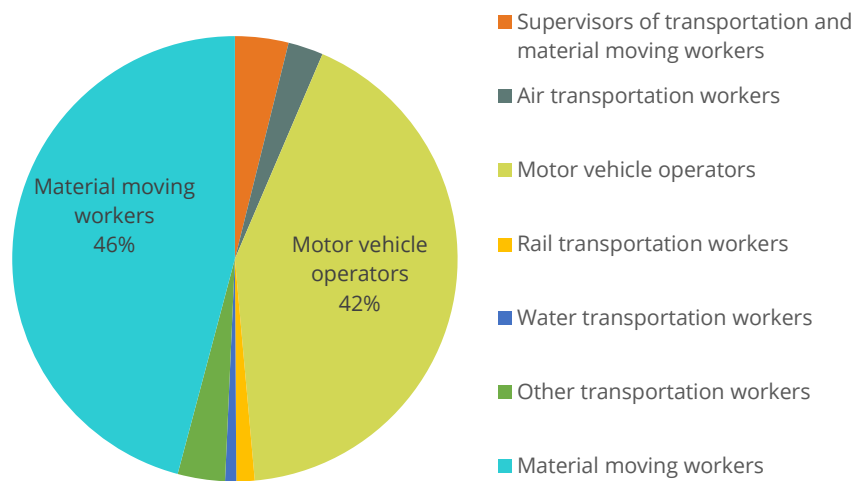


Figure 2. Tennessee employment projections for Transportation and Material Moving and related occupations with positive openings projected 2014-2024²⁹

Occupation	2014 Estimated Employment	2024 Projected Employment	Total 2014 - 2024 Employment Change	Annual Avg. Percent Change	Median Salary
Laborers and Freight, Stock, and Material Movers, Hand	77,840	92,710	14,870	1.8%	\$25,820
Transportation, Storage, and Distribution Managers	3,680	4,050	370	1.0%	\$72,230
Heavy and Tractor-Trailer Truck Drivers	60,150	67,140	6,990	1.1%	\$39,430

29 Tennessee Department of Labor and Workforce Development, Jobs4TN Online. (2016). Occupational Projections on the internet at <https://www.jobs4tn.gov/vosnet/analyzer/results.aspx?session=occpj>

Packers and Packagers, Hand	17,240	19,600	2,360	1.3%	\$21,250
Light Truck or Delivery Services Drivers	22,940	24,740	1,800	0.8%	\$30,320
Industrial Truck and Tractor Operators	17,820	18,420	600	0.3%	\$ 29,700
Bus Drivers, School or Special Client	9,850	10,320	470	0.5%	\$25,540
Bus Drivers, Transit and Intercity	2,580	2,650	70	0.3%	\$36,080
First-Line Supervisors of Mechanics, Installers, and Repairers	8,980	9,850	870	0.9%	\$59,260
Managers, All Other	12,500	13,790	1,290	1.0%	\$77,680
Logisticians	1,190	1,440	250	2.0%	\$77,210
Captains, Mates, and Pilots of Water Vessels	920	1,150	230	2.2%	\$72,680

Material Moving Workers

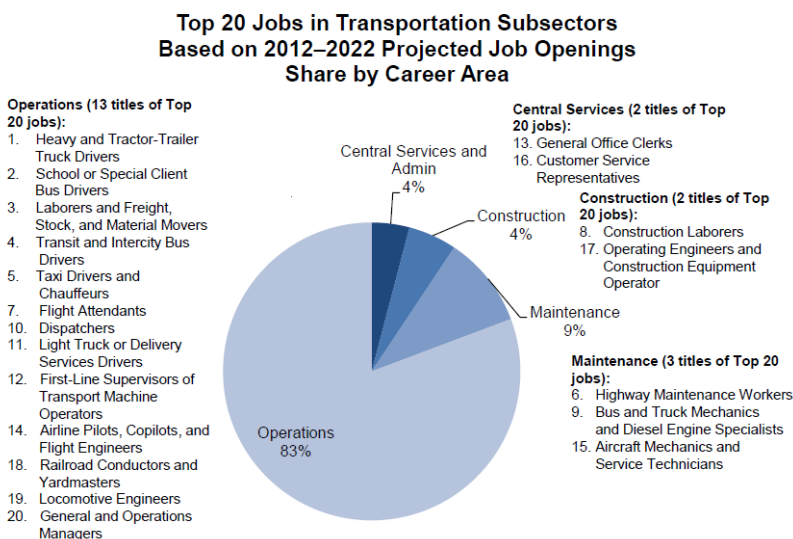
In Tennessee, the occupation group with the largest number of openings expected is the material moving workers group with a net growth of 14,870 projected from 2014 to 2024. However, median salaries in this group are low.

Transportation Subsectors

“The jobs in greatest demand are semi-skilled and skilled jobs in operations and maintenance,” according to a national report by the U.S. Department of Education. Opportunities in operations jobs greatly exceed the demand for those in central services. In fact, 83 percent of the top 20 jobs with

the most projected openings falling in the operations category. (See **Figure 3**).³⁰ Nationally and in Tennessee, heavy and tractor-trailer truck drivers has the largest number of projected job openings within the occupation groups not including material moving workers. Of the six subsectors identified in the U.S. Department of Education report, trucking accounted for 42 percent of the industry employment in 2014. **Figure 4** illustrates the additional breakout by sector.

Figure 3. Top 20 Jobs Nationally in Transportation Subsectors Based on 2012-2022 Projected Job Openings Share by Career Area.



³⁰ U.S. Department of Education, Office of Career, Technical, and Adult Education. (2015, August). *Strengthening Skills Training and Career Pathways across the Transportation Industry*. Washington, D.C. Retrieved from <http://cte.ed.gov/initiatives/advancing-cte-in-state-and-local-career-pathways-system>.

Figure 4. Top 20 Jobs Nationally in Transportation Subsectors Based on 2012-2022 Projected Job Openings Share by Career Area.

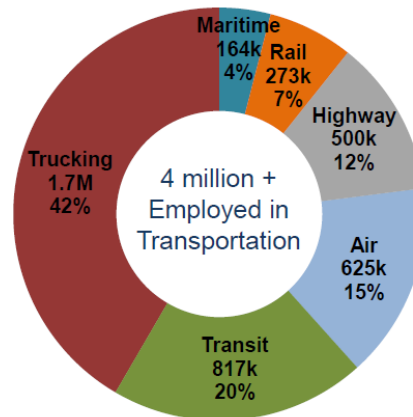


Figure 5. State and national trends for Transportation, Storage, and Distribution Managers with positive projections 2014-24.³¹

	Employment		Percent Change	Projected Annual Job Openings
	2014	2024		
National				
Transportation, Storage, and Distribution Managers	111,600	114,100	2%	2,700
Tennessee	Employment		Percent Change	Projected Annual Job Openings
	2014	2024		

31 Career One Stop. (2017). *Occupation Profile, State and National Trends*. Retrieved from <http://www.onetonline.org/link/summary/21-1093.00>

National	Employment		Percent Change	Projected Annual Job Openings
	2014	2024		
Transportation, Storage, and Distribution Managers	3,680	4,050	10%	120

The Memphis area has been identified as a sweet spot for infrastructure jobs, a designation which includes occupations in both transportation and construction industries. A Brookings Institution report ranks Memphis as No. 1 among the nation's largest metro areas for its 17.8% share of infrastructure jobs out of the total employed.³² The study also identified Chattanooga as No. 5 with 13.8% infrastructure share, Knoxville No. 18 with 12.3% infrastructure share, and Nashville-Davidson No. 24th with 12.0% infrastructure share.³³ **Figure 6** illustrates this finding.

Figure 6. Annual average openings for transportation and material moving occupations in Tennessee (2014-2022)



³² McKenzie, K. (2014, May 10). New Study Highlights Memphis Area as No. 1 in Infrastructure Jobs. The Commercial Appeal. Retrieved from <http://www.commercialappeal.com/business/new-study-highlights-memphis-area-as-no-1-in-infrastructure-jobs-ep-457579999-323693121.html>.

³³ Kane, J., & Puentes, R. (2014, May 9). Beyond Shovel-Ready: The Extent and Impact of U.S. Infrastructure Jobs. Retrieved March 02, 2016, from <http://www.brookings.edu/research/interactives/2014/infrastructure-jobs#/M10420>

Managers, Supervisors, & Logisticians

While the large bulk of occupations in Tennessee in Distribution and Logistics are material moving workers and motor vehicle operators (jobs where a high school diploma or less is needed), occupations for logisticians, transportation managers, and supervisors of transportation and material workers are anticipated to grow. These occupations also typically have higher salaries. Annual average openings 2014-24 and 2016 median salaries are listed in Figure 7.

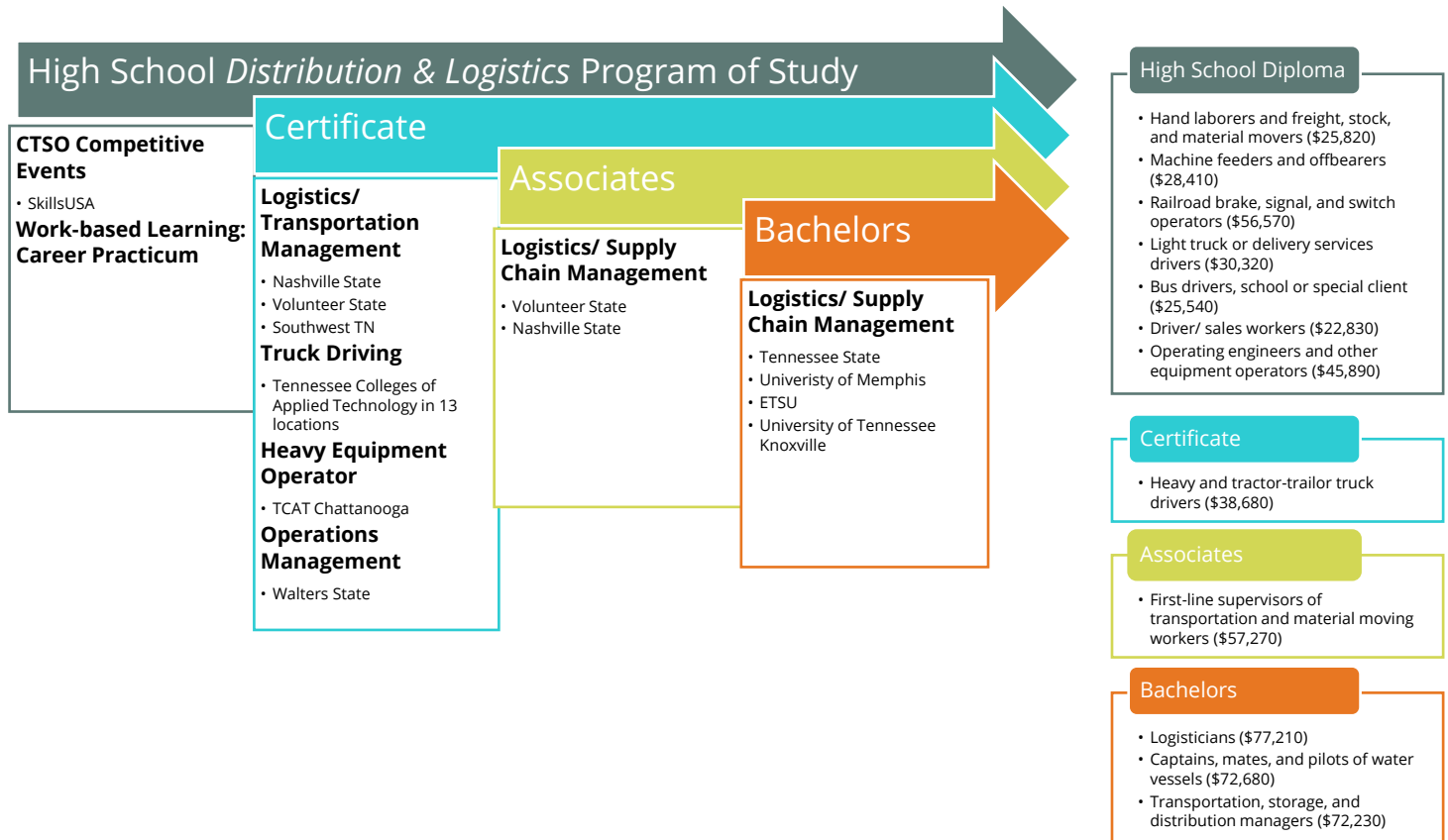
Figure 7. Transportation managers, supervisors, & logisticians occupations with 50 or more annual average openings projected in Tennessee, 2014-24.

Occupation	Total Percent Change	Total Employment Change	Median Salary
First-Line Supervisors of Mechanics, Installers, and Repairers	9%	870	\$59,260
Transportation, Storage, and Distribution Managers	10.0%	370	\$72,230
Logisticians	21%	250	\$77,210

Postsecondary Pathways

Upon completion of this program of study, students will be prepared to enter the workforce or to further their training at postsecondary institutions. The chart below outlines the related career opportunities and the training necessary for each. A high school diploma is entry level expectation for many occupations, but postsecondary education is necessary for many. Almost 40 percent of jobs in transportation, distribution, and logistics will require at least some postsecondary education by 2018.³⁴ A high school diploma is typically the minimum requirement for hand material movers, light truck drivers, water and rail transportation workers, and operating engineers. Heavy and tractor-trailer drivers complete training courses and must obtain a Commercial Driver's License (CDL). An individual must be 18 years old to truck intrastate and 21 years old to truck interstate in a heavy truck or tractor-trailer. For logisticians and transportation managers, a bachelor's degree is usually necessary, but the salaries for these individuals are at least double many of those requiring a high school diploma.

³⁴ Carnevale, A. P., Smith, N., Stone III, J. R., Kotamraju, P., Steuernagel, B., & Green, K. A. (2011). *Career Clusters: Forecasting Demand for High School Through College Jobs*. Washington, DC: Georgetown University Center on Education and the Workforce.



Current Secondary Landscape

This program of study was offered in only a few schools during the 2014-15 and 2015-16 school year. Two of the schools were located in Shelby County. The number of schools increased for the 2016-17 school year to 15 and projects to increase by two for 2017-18.

Figure 5. Open Enrollment Analysis³⁵

SY	Distribution and Logistics
2013-14	No data
2014-15	3
2015-16	3
2016-17	15
2017-18	17

Student Enrollment

SY	Foundations of Transportation, distribution, and Logistics	Distribution and Logistics I	Distribution and Logistics II: Management -or- Dual Enrollment Distribution & Logistics	Work-Based learning: Career Practicum -or- Dual Enrollment Distribution & Logistics
2013-14	50	52	23	0
2014-15	59	62	1	0
2015-16	52	52	0	0
2016-17	N/A	N/A	N/A	N/A

³⁵ Tennessee Department of Education. (2017). *Student Enrollment Data*. Retrieved from Author's calculation of student enrollment data.

Distribution and Logistics Concentrators

SY	Distribution and Logistics Concentrators
2013-14	N/A
2014-15	0
2015-16	45
2016-17	N/A

Recommendation

Because of a variety of factors, changes should be made to make the Distribution & Logistics POS a more relative program for the ever-changing industry. First, D&L should be changed to the more industry-accepted title, Supply Chain Management. SCM encompasses the end-to-end nature of this industry and helps remove any preconceived ideas about the nature of work. Levels 1, 2, 3 shall be revamped to reflect the current needs and trends in the Supply Chain Management industry. Due to the large amount of business and marketing content in the program of study, it is suggested that this program of study be moved to Marketing career cluster to capitalize of their knowledge of distribution and placement, and to reflect industry qualifications.

Because of the large number of job opportunities available, more schools should be offering this program of study across the state. Moving this program of study to the Marketing career cluster will make it easier for schools to offer it. Marketing materials may help promote this program of study and breakdown any preconceived notions about the nature of the work. Lastly, as the Supply Chain Management Program develops, evaluation of adding the SCPro certification endorsed by the Council of Supply Chain Management Professionals (CSCMP) should be examined.

2017-18 Program of Study	Level 1	Level 2	Level 3	Level 4
Supply Chain Management	Foundations of Transportation, Distribution, and Logistics (6069)	Supply Chain Management I (6072)	Supply Chain Management II (6024) -or- Dual Enrollment Supply Chain Management (4132)	Work-Based Learning: Career Practicum (6105) -or- Dual Enrollment Supply Chain Management (4132)

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